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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/772,280	02/06/2004	Masahiro Koike	248684US2SRD	4940
22850	7590	10/24/2005	EXAMINER	
OBLON, SPIVAK, MCCLELLAND, MAIER & NEUSTADT, P.C. 1940 DUKE STREET ALEXANDRIA, VA 22314			HO, TU TU V	
			ART UNIT	PAPER NUMBER
			2818	

DATE MAILED: 10/24/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/772,280

Applicant(s)

KOIKE ET AL.

Examiner

Tu-Tu Ho

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 September 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-8 and 10-23 is/are pending in the application.
- 4a) Of the above claim(s) 13-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-8,10-12 and 21-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 06 February 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Applicant's Amendment filed 09/16/2005 has been reviewed and placed of record in the file.

2. Applicant's arguments with respect to amended claims 1, 3-8, 10-12, and 21-23, filed 09/16/2005, have been considered but they are moot in view of new ground(s) of rejection.

Election/Restrictions

3. This application contains claims 13-20 drawn to an invention nonelected with traverse in the reply filed on 05/25/2005. A complete reply to the final rejection must include cancellation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

Claim Rejections § 102 & § 103

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

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The following is a quotation of 35 U.S.C. §103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. **Claims 1, 3-5, 7-8, 10-11, and 21-23** are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Pomarede et al. U.S. Patent Application Publication 20020098627 (which is a publication of application 09/944,734, which is the parent application of Application Publication 20040147101, which was cited in a previous office action; U.S. Patent Application Publication 20020098627 is cited in this office action so as to meet the requirement of 35 U.S.C. 102(b) “more than one year prior to the date of application for patent in the United States”; hereinafter U.S. Patent Application Publication 20020098627 will be referred to as the ‘627 reference).

Referring to claims 1, 7-8, and 21, the ‘627 reference teaches a semiconductor device comprising a substrate (200, Figs. 4’s) including a channel region (not shown but inherent for the device to function) ; an insulating film (260) formed above the substrate and including a metal, Si, N, and O (the base materials, HfO₂, representing the metal and the O of the claim, are formed by deposition step 120 – paragraph [0068] and Fig. 3, the Si is formed by the treatment step 110 – paragraph [0066] – which is represented as Si-N bonds, the N is formed under an excited state by the treatment step 110 and step 125 – paragraphs [0066] and [0084]-[0085] – which is represented as metal-nitrogen bonds, which “nitrogen” is the same as the N of the claim); a gate electrode (220) formed above the insulating film (also called a gate insulating film in the art and by claim 7), and a pair

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of source/drain (also called impurity diffusion regions in the art and by claim 7) that is inherent for the device to function - but not shown - sandwiching the not-shown channel region.

However, the reference does not disclose that the insulating film that includes metal, Si, N, and O includes metal-N bonds in an amount of 1 atomic % or more as recited in claims 1, 8, and 21, thus also fails to disclose a spectrum peak at a bonding energy of a metal-N bond as recited in claim 21.

Nevertheless, as mentioned above and as being deducible by a person of ordinary skill in the art, the bulk of the insulating film is HfO_2 , which is basically metal-oxygen bonds, following the deposition step 120. The reference then teaches, in step 125 that follows step 120 (Fig. 3), that process parameters are selected to replace metal-oxygen bonds – the bulk of the insulating film – in the upper monolayers (atomic layers that constitute the insulating film) with metal-N bonds (metal-nitrogen bonds, paragraph [0090]). Therefore, it would appear that the bulk of the insulating film in at least in the upper monolayers of the insulating film contains metal-N bonds, meeting the claimed limitation “metal-N bonds in an amount of 1 atomic % or more”. In addition, another reason that one of ordinary skill in the art would be lead to conclude that the ‘627 reference’s insulating film includes metal-N bonds in an amount of 1 atomic % or more is that the insulating film, being insulating, can not include too many metal-metal or metal-semimetal (i.e., Hf-Si) bonds because these bonds are not characteristics of insulating films.

Referring to the limitation “being amorphous” in “the insulating film being amorphous” of **claim 8**, the ‘627 reference teaches that the insulating film could be amorphous (paragraph [0081]).

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Referring to **claim 3**, as evident from the teachings of the '627 reference and as noted above, the bulk of the insulating film is the metal oxide of the layer 260, and the Si of the insulating film is from the treatment step 110, which Si is from the underlying semiconductor silicon layer, therefore it appears that the insulating film contains more metal and less Si and consequently an insulating film containing more metal and less Si meets the limitation that a content of the metal in the insulating film is 47 atomic% or more based on the total amount of the metal and Si..

Referring to **claims 4 and 10**, the metal of the '101 reference is Hf (from HfO_2), meeting the limitation of the claimed Markush group.

Referring to **claims 5 and 11**, as noted above, the metal of the '101 reference is Hf, and the insulating film includes Si-N bonds (paragraph [0066], Hf-O bonds (from HfO_2), and Hf-N bonds (paragraph [0085], "metal-nitrogen bonds", where metal is Hf). Compared to the claims, the reference appears to lack Si-O bonds. However, the reference teaches forming the HfO_2 layer on the Si (silicon) semiconductor layer ("deposition 120", paragraph [0068]). It appears that the O of the HfO_2 will react with the underlying silicon to form the claimed Si-O bonds.

Referring to **claim 22**, the '101 reference does not disclose a metal-metal bond for the insulating film, therefore the insulating film has no spectrum peak at a bonding energy of a metal-metal bond.

Referring to **claim 23**, as noted above for claims 5 and 11, the '101 reference discloses Si-N bonds, metal-O bonds (Hf-O bonds, from HfO_2), and Hf-N bonds, and appears to disclose Si-O bonds. The reference further discloses no other bonds. Therefore, the reference discloses that the insulating film has other spectrum peaks at binding energies of a metal-O bond, a Si-N

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bond, that the insulating film appears to have another spectrum peak at binding energy of Si-O bond, and that the insulating film has no other spectrum peak(s) at a binding energy.

Claim Rejections - 35 USC § 103

5. **Claims 6 and 12** are rejected under 35 U.S.C. §103(a) as being unpatentable over Pomarede et al. U.S. Patent Application Publication 20020098627 (the '627 reference).

The '627 reference discloses a semiconductor device including the insulating film as claimed and as detailed above for claims 5 and 11 including compositions having Si-O, Si-N, Hf-O, and Hf-N bonds. Although the reference does not represent the compositions with the formula as claimed, the insulating film compositions could be represented as claimed, as detailed in the specification of the present invention, page 7.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office Action. See MPEP § 706.07(a). While it is true that the added limitation "1 atomic % or more" per se is not a new limitation, the limitation when combined with the amended claims have produced a new combination.

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after


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the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tu-Tu Ho whose telephone number is (571) 272-1778. The examiner can normally be reached on 6:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, DAVID NELMS can be reached on (571) 272-1787. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Tu-Tu Ho
October 17, 2005